Giant Garter Snake
(***Thamnophis gigas***)

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Status

Federal: Threatened (USFWS 1993)

State: Threatened

Other: World Conservation Union (IUCN): Vulnerable

Recovery Plan: Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*) (USFWS 1999). Final Recovery Plan to be completed in 2010.

Critical Habitat: No critical habitat rules have been published for the giant garter snake.

Placer Legacy Category: Class 2

Distribution

California

Giant garter snake is endemic to California, found only in the Sacramento and San Joaquin Valleys (Fitch 1941; Hansen and Brode 1980; Rossman and Stewart 1987; USFWS 1999). Records of giant garter snakes coincide roughly with the historical distribution of the large flood basins, freshwater marshes, and tributary streams of the Central Valley of California (Hansen and Brode 1980). The distributional range of this species probably extended from Butte County in the north to Buena Vista Lake in Kern County in the south. The eastern and western boundaries of the range are believed to be the foothills of the Coast Ranges and the Sierra Nevada (USFWS 1999). Rossmann et al. (1996) described an elevational range for giant garter snake of 0–400 feet elevation. Occurrence records in the southern Sacramento Valley occurred between 10–40 feet elevation (Hansen 1986). Agricultural and flood control activities have extirpated the species from the southern one-third of its range in the former wetlands associated with the historic Buena Vista, Tulare, and Kern lakebeds (Hansen and Brode 1980; Hansen 1986, 1988; California Department of Fish and Game 1992; USFWS 1999). Today, populations of giant garter snake are found in the Sacramento Valley and isolated portions of the San Joaquin Valley (USFWS 1999; USFWS 2006; California Natural Diversity Database 2009). Recent records indicate 13 recognized populations distributed from the vicinity of Chico in Butte County to near Burrel in Fresno County (Hansen and Brode 1980; Rossman and Stewart 1987; USFWS 1999; USFWS 2006; California Natural Diversity Database 2009).

Placer County Plan Area

<u>Historical</u>

The western third of the Plan area occurs within the Central Valley proper and supports numerous low-elevation tributaries and wetlands that could have provided suitable habitat for this species. However, there are no historical records of this species in the Plan area.

Current

There are no current records of giant garter snake within the Placer County Plan area. However, suitable habitat occurs in the drainage network associated with agricultural fields in the western section of the county (USFWS 1999; USFWS 2006). A total of 19 occurrences of giant garter snake have been reported within five miles to the west and south of the Placer County line in the Sutter and Natomas Basins of Sutter and Sacramento Counties (California Natural Diversity Database 2009). The closest occurrence was recorded in the Natomas Basin of Sacramento County approximately 1.5 miles to the southwest of the Placer County line. Another population occurs in Auburn Ravine, west of the Plan area in Sutter County (Paquin et al. 2006).

Population Status & Trends

California

The current distribution and abundance of giant garter snake is reduced and declining due to loss, degradation, and fragmentation of habitat (USFWS 1999). Prior to 1970, the species was known from 17 populations (Hansen and Brode 1980). At the time of listing in 1993, 13 of these populations were extant; only three of these populations are currently considered stable and safe from threats.

Placer County Plan Area

There are no known records of giant garter snakes in the Plan area. Consequently, the status of any population that may occur there is unknown.

Natural History

The habitat requirements, ecological relationships, life history, and threats to giant garter snake described below are summarized in diagram form in the envirogram (Figure 1).

Habitat Requirements

Giant garter snake inhabits agricultural wetlands and associated waterways. These include irrigation and drainage canals, rice fields, marshes, sloughs, ponds, small lakes, low-gradient streams, and adjacent uplands (USFWS 1999). Features of these habitats important to giant garter snakes include: sufficient water during the snake's active season (early spring through mid-fall) to maintain an adequate prey base; emergent vegetation such as cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.) for escape cover and foraging habitat; upland habitat with grassy banks and openings to waterside vegetation for basking; and adjacent upland areas for cover and refuge from floodwaters during the species' inactive season (Hansen 1980; Hansen 1988; Brode and Hansen 1992; Hansen and Brode 1993). In addition, irrigated pastures provide indirect habitat for giant garter snake because the pastures require early summer flooding of pastures and frequent irrigation—often from a maze of irrigation canals (Paquin et al. 2006; Paquin, pers. comm.).

Giant garter snake is absent from larger rivers; wetlands with sand, gravel, or rock substrates; and from riparian woodland areas lacking suitable basking sites or suitable prey populations (Hansen 1980; Rossman and Stewart 1987; Brode 1988; Hansen 1988; USFWS 1999).

Although many wildlife refuges within the range of giant garter snake contain wetlands, those that use "wet-soil management" do not provide suitable habitat for giant garter snakes (Paquin et al 2006). In wet-soil management, the wetlands are left to dry in the summer months in order to promote the growth of wetland plant species that provide food for overwintering waterfowl

(Paquin et al 2006). Therefore, this type of management does not provide enough aquatic habitat during the snake's active season.

According to the Draft Recovery Plan for the Giant Garter Snake (USFWS 1999), the ideal concept of a marsh managed as giant garter snake habitat should have shallow and deep water and variations in topography, including some higher ground resembling the ditch banks, or "islands", similar to a rice check. Rice fields contain warm shallow water with sheltering emergent vegetation (i.e. rice plants), which is present within the fields during the giant garter snake active season in the spring, summer, and early fall. During the late summer when rice fields contain large numbers of mosquito fish and Pacific tree frogs, rice fields may provide important nursery areas for newborn giant garter snakes (Brode and Hansen 1992, Hansen and Brode 1993). The habitat and its associated water conveyance system, if managed properly, provides the giant garter snake ease of movement; protection from predators; warmth to aid metabolism, gestation, and digestion; and a source of food.

The diverse habitat elements of ricelands; the rice fields, tail water marshes, the ditch and drain components of the water conveyance system, delivery canals, and associated levees, all contribute structure and complexity to this man-made ecosystem. Giant garter snakes can survive in this artificial ecosystem because the spring and summer flooding and fall dry-down of rice culture coincides fairly closely with the biological needs of the species (USFWS 1999). Giant garter snake utilizes ricelands extensively and depends on them for habitat. In the spring, when the rice is planted and the fields are flooded with several inches of water, they contain prey species such as small fish or frogs attract giant garter snakes. In the summer, while the flooded rice continues to grow, giant garter snake continues to use rice fields as long as their prey are present in sufficient densities. In the late summer and fall, when the water is drained from the rice fields, giant garter snake moves off the fields to other adjacent habitats. Rice is harvested at this time and female garter snakes have just borne young and need food to regain their body weight; in the fall, the snake can get a good supply of food from the rice lands because prey are concentrated in the rice drains. In the winter, while the rice fields are fallow, giant garter snakes are dormant.

Within rice fields and the irrigation canals, giant garter snake also basks in openings in vegetation, created by riprap placed around water control structures. Giant garter snake uses small mammal burrows and other soil crevices above prevailing flood elevations during the winter (i.e., November to mid-March). Giant garter snake typically selects burrows with sunny exposures along south and west facing slopes (USFWS 1999). Small mammal burrows, crayfish burrows, and soil crevices provide retreats from extreme heat for giant garter snake during the active season (Hansen and Brode 1993). Wintering sites varied from canal banks and marsh locations, to riprap along a railroad grade near the marsh (Wylie et al. 1997). Wintering locations of radio-telemetered snakes tended to be in the vicinity of spring capture sites.

Individuals have been found using burrows as far as 164 ft from marsh edges during the active season, and as far as 820 ft from the edge of wetland habitats while overwintering, presumably to reach hibernacula above the annual high water mark (Hansen 1986, Wylie et al. 1997, USFWS 1999).

Reproduction

Giant garter snake is live bearing. The breeding season lasts from March into May and resumes briefly during September (USFWS 1999). Males begin searching for females immediately after emergence from overwintering sites. Females brood young internally and

typically give birth to 10–46 young (mean = 23) from late July through early September (Hansen and Hansen 1990).

Foraging Behavior

Giant garter snake feeds primarily on fish and amphibians, taking advantage of pools that trap and concentrate prey (Brode 1988; Hansen 1980; Hansen 1988; Hansen and Brode 1993). Prey species include bullfrog (*Rana catesbeiana*), Pacific chorus frog (*Pseudacris regilla*), carp (*Cyprinus carpio*), mosquitofish (*Gambusia affinis*), and blackfish (*Othodox microlepidotus*) (Fitch 1941; Fox 1952; Cunningham 1959; Hansen 1980; Brode 1988; Hansen and Brode 1993; Rossman et al. 1996).

Dispersal Patterns

No estimates of dispersal distances have been reported for giant garter snake. Newborn giant garter snakes disperse into dense cover immediately after birth and absorb their yolk sacs, after which they begin fending for themselves (USFWS 1999). Adults may disperse away from seasonal wetlands or rice fields when they dry up.

Demography

Giant garter snake is about 8 inches long at birth. It typically doubles in size by one year of age (USFWS 1999); males usually reach sexual maturity in three years and females in five years. Sex ratios of adult females to males vary from 1:1 to 2:1, but this variance may be a function of capture methods employed in different studies (Hansen and Brode 1993; Wylie et al. 1997; USFWS 1999). Adult females are on average longer and heavier than males; males can reach 32.3 inches in snout-vent length (mean = 26.2 inches) and females can reach 42.5 inches snout-vent length (mean = 34.9 inches). Males weigh up to 10.2 ounces (mean = 4.9 ounces) and females weigh up to 27.7 ounces (mean = 15.3 ounces) (USFWS 1999).

There are few population estimates for giant garter snake. Mark and release studies have produced varied results. Some of these estimates are: 84 snakes in a 1 square-mile area of rice land in the Natomas Basin (Hansen and Brode 1993); 1,000 snakes within one square mile (USFWS 1999); 206 individuals in Gilsizer Slough (3,500 acres) (USFWS 1999); 132 individuals in the Colusa National Wildlife Refuge (11,120 acres); and 191 giant garter snakes in Badger Creek Marsh (580 acres).

Longevity

No information is available on the longevity or survival rates of giant garter snake; such estimates are very limited for the genus as a whole. The best survivorship data available for garter snake is from a study of *T. sirtalis* in northern California. The results of this study show one- and two-year survivorship of neonates to be 28.7% and 16.4%, respectively; yearly survivorship was 50.8%, and annual survivorship of individuals more than two years old was only 32.7 % (Rossman et al. 1996).

Sources of Mortality

Giant garter snakes are subject to widespread mortality from habitat loss, increased predation in degraded habitats, vehicular traffic, contamination from pesticides and other toxins, agricultural practices, water maintenance activities, and flooding (USFWS 1993, 1999).

Behavior

Home range estimates for giant garter snake based on radio telemetry data vary with location; estimates averaged 47 acres in Gilsizer Slough (n = 27; range: 2.0–640 acres);131 acres in

Colusa National Wildlife Refuge (n = 29; range: 3.2–2,792 acres); and 23 acres at Badger Creek (n = 8; range: 10.4–202.6 acres) (USFWS 1999).

Movement, Migratory, and Activity Patterns

Giant garter snake is most active from early spring through mid-fall; activity is dependent on local weather conditions (Brode 1990; Hansen and Brode 1993). Giant garter snake begins to emerge from winter retreats around April 1. By the beginning of May, all giant garter snakes have usually emerged and are actively foraging. By about October 1, giant garter snakes begin seeking winter retreats. Foraging and other activities are sporadic at this time and dependent on weather conditions. By November 1, most snakes are in winter retreats and will remain there until spring. During winter, giant garter snake is generally inactive, although some individuals may bask or move short distances on warmer days (USFWS 1999). During the active season, giant garter snake generally remains near wetland habitats but can move more than 800 feet from the water (Hansen 1988; Wylie et al. 1997) during the day. Some individuals may move up to five miles over a period of several days if the conditions of their habitat become unsuitable (e.g., as a result of flooding) (Wylie et al. 1997).

As discussed above, giant garter snake uses burrows in the summer as much as 164 feet away from the marsh edge, whereas, overwintering snakes use burrows as far as 820 feet from the edge of marsh habitat (Wylie et al. 1997).

Ecological Relationships

Giant garter snake preys on a variety of fish and amphibians available within its habitat; it is in turn prey for raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), red foxes (*Vulpes vulpes*), gray foxes (*Urocyon cinereoargenteus*), hawks (*Buteo* spp.), northern harriers (*Circus cyaneus*), great egrets (*Ardea alba*), snowy egrets (*Egretta thula*), American bitterns (*Botaurus lentiginosus*), and great blue herons (*Ardea herodias*). Giant garter snakes may coexist with two other species of garter snake: valley garter snake (*T. sirtalis fitichi*) and western terrestrial garter snake (*T. elegans*) (Hansen 1980; Hansen 1986). This coexistence may be possible because of differences in foraging behavior (USFWS 1999).

Population Threats

Loss, degradation, and fragmentation of habitat are the primary threats to the viability of giant garter snake populations (USFWS 1999). Conversion of wetlands for agricultural, urban, and industrial development has resulted in the loss of more than 90% of suitable habitat for this species in the Central Valley. Degradation of habitat, including maintenance of flood control and agricultural waterways, weed abatement, rodent control, discharge of contaminants into wetlands and waterways, and overgrazing in wetland or streamside habitats, may also cumulatively threaten the survival of some giant garter snake populations (Hansen 1988; Brode and Hansen 1992; California Department of Fish and Game 1992; Hansen and Brode 1993).

The introduction of nonnative predators, including bullfrog, largemouth bass (*Micropterus salmoides*), and catfish (*Ictalurus* spp.), has been responsible for eliminating many species of native fishes and aquatic vertebrates in the western United States (Minkley 1973; Moyle 1976; Holland 1992). Exotic species have probably had detrimental effects on the giant garter snake through direct predation (sensu Bury and Whelan 1984; Treanor 1993) and competition for smaller forage fish (California Department of Fish and Game 1992; Hansen 1986; Schwalbe and Rosen 1989).

Toxic contamination, particularly from selenium, and impaired water quality have also been identified as threats to some populations of the giant garter snake (Ohlendorf et al. 1986; Saiki

and Lowe 1987; USFWS 1993). Preliminary studies have documented potential bioaccumulative effects on giant garter snake or its prey species caused by agriculturally derived contaminants (see Saiki et al. 1992, 1993). Disease and parasitism, potentially exacerbated by compromised immune response ability as a result of contaminant exposure, may also pose a threat to this species (USFWS 1999).

Conservation Considerations

Status of Recovery Planning

Giant garter snake was listed as threatened in California in 1971; it was federally listed in 1993. Subsequent conservation actions have included establishment of guidelines and mechanisms to minimize and mitigate take (USFWS 1999); habitat and population surveys (Hansen 1982, 1986, 1996; Hansen and Brode 1980); and development of management plans for public lands and land acquisitions (USFWS 1999). A draft recovery plan for giant garter snake was completed in 1999. A final recovery plan is set to be completed in early 2010 (Kelly, pers. comm. 2009).

Compatible Land Uses

Rice fields currently provide a significant amount of giant garter snake habitat; however, flooding makes thousands of acres uninhabitable, and burning the fields in winter leaves snakes exposed to increased predation and thermal stress upon spring emergence. Establishing management practices that are compatible with giant garter snake ecology should enhance the perpetuation of the species. By changing the timing of water management and the method and timing of ditch and field maintenance, rice farmers can minimize impacts on this species (Engles 1994).

Context for a Regional Conservation Strategy

There are no records of giant garter snake in western Placer County; however, the species has been recorded in the region and specifically in neighboring Sutter and Sacramento counties and suitable habitat is present within the Plan area. Records of giant garter snake are restricted to the Sacramento and San Joaquin Valleys. The widest range is within the Sacramento Valley, where there are historical or current records of giant garter snake from nine counties. As the western boundary of the Plan area touches into the region of highest giant garter snake density based off of California Natural Diversity Database records, conservation of potential habitat within western Placer County is stressed. For the conservation of giant garter snake within the Plan area, agricultural wetlands and associated waterways are of highest conservation and/or acquisition priority.

Modeled Species Distribution in the Plan Area

Model Assumptions

<u>Breeding, Foraging, and Movement Habitat (Primary Habitat)</u>
Modeled habitat includes the following land-cover types below 200 feet: stock pond, fresh emergent wetland, seasonal wetland, flooded rice, and riverine (only smaller, low-gradient streams, tributaries, and canals).

Upland Habitat (Secondary Habitat)
Modeled habitat includes the following land-cover types below 200 feet elevation and within 900 feet of the edge of wetland habitats: annual grassland, pasture, alfalfa, irrigated pasture, and row crop. Riverine land-cover type was also included as movement habitat.

Rationale

Giant garter snakes require sufficient water during the snake's active season (early spring through mid-fall) to maintain an adequate prey base; emergent vegetation for escape cover and foraging habitat; adjacent upland habitat with grassy banks and openings to waterside vegetation for basking; and adjacent upland areas for cover and refuge from floodwaters during the species' inactive season. They are known to inhabit agricultural wetlands and associated waterways including irrigation and drainage canals, rice fields, marshes, sloughs, ponds, small lakes, low-gradient streams, and adjacent uplands. Giant garter snakes inhabit small mammal burrows and other soil crevices above prevailing flood elevations throughout the winter dormancy period (November to mid-March). Individuals have been found using burrows as far as 165 ft from marsh edges during the active season, and as far as 820 ft from the edge of wetland habitats while overwintering, presumably to reach hibernacula above the annual high water mark (Hansen 1986, Wylie et al. 1997, USFWS 1999). Primary habitat includes breeding, foraging, and movement habitat because breeding habitat could not be differentiated from foraging and movement habitat at the resolution of the GIS land-cover data. Also, giant garter snake may use breeding habitat for foraging and movement. Upland habitats were conservatively modeled to include suitable land-cover types with 900 feet of the edge of wetland habitats.

Model Results

Figure 2 shows the modeled potential habitat for giant garter snake within the Plan area. The majority of the modeled habitat occurs in the far western portion of the Plan area that supports flooded rice and other suitable agricultural lands.

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Envirogram Narrative

Giant Garter Snake (*Thamnophis gigas*)

The envirogram was created based on the information provided in this species account. The envirogram is a tool to help depict and organize the most important ecological factors that affect a population or group of populations of a particular species. The envirogram consists of Direct Components – components of the environment that directly affect a species' chances to survive and reproduce, and several webs comprised of distal factors (i.e., Indirect Components, Management Problems, and Mitigation Actions) that act in sequence to affect the Direct Components. The Direct Components consist of four major categories: resources, hazards, reproduction, and dispersal. Each of these is subdivided as necessary.

The webs identify the underlying ecological processes or human actions that influence each Direct Component. Distal factors in the web activate proximate components. Each of these pathways in the web are constructed from right to left, with Indirect Components immediately to the left of Direct Components directly affecting the Direct Component, and secondary Indirect Components affecting primary Indirect Components. Management Problems can directly affect the Indirect Components, and Mitigation Actions provide solutions to remedy the Management Problems.

Resources

Res1: Giant garter snake originally was found in fresh emergent wetlands, ponds, small lakes with appropriate shoreline, and low gradient streams in the Central Valley. These areas required a particular topography and a water source, either precipitation or natural drainage. The construction of dams and diversions and the filling and draining of wetlands for agriculture and development has eliminated most of this habitat type. Substantial wetland restoration will be required to mitigate the loss.

Res2: Giant garter snake now mostly inhabits drainage networks associated with agriculture, particularly rice fields. The dams and diversions that helped destroy its original habitat have made possible the irrigation that maintains this new one. Bad timing of water releases and shutoffs can make these fields unsuitable for giant garter snake, however, so water management must take the giant garter snakes' needs into account.

Res3: During its active season the giant garter snake needs enough water in its habitat to support a prey base. The water can come either from precipitation and drainage and a natural flow regime or from irrigation. The suitability of irrigation water depends on the timing of water releases and shutoffs as in path Res2.

Res4: Giant garter snake needs emergent vegetation for cover and foraging habitat. This requires persistent water during the giant garter snake's active season, either from natural flow or irrigation. Burning or treating emergent vegetation with herbicide results in unsuitable habitat for the giant garter snake; emergent vegetation must be allowed to grow during the giant garter snake's active season.

Res5: Giant garter snake also requires grassy banks for basking. Thus, herbaceous riparian vegetation should not be overgrazed, and livestock should be excluded from the edges of fields and ditches.

Res6: During the inactive season, giant garter snake hibernates in mammal burrows or crevices above the high water line. This means that levees or natural topographic features must be present in otherwise level—or leveled—areas and that some rodent burrowing must be tolerated in giant garter snake habitat.

Res7: Giant garter snake feeds on fish, amphibians and their eggs, and invertebrates. The presence of these organisms requires a functioning wetland ecosystem with unpolluted water persisting during the giant garter snakes' active season. Proper pesticide application and timing of irrigation releases are critical.

Hazards

Haz1: Loss and degradation of habitat, either by filling and draining natural wetlands or by converting rice fields and other suitable agricultural areas to suburbs, vineyards, and orchards, is the major hazard to giant garter snake. Active wetland restoration and agricultural and conservation easements can help mitigate this loss.

Haz2: Drowning during winter dormancy is another hazard faced by the giant garter snake. Drowning occurs when normal high water marks are exceeded either by natural floods or by modifying water management practices. Agricultural practices that accommodate the giant garter snake's needs should be encouraged and made part of conservation easements.

Haz3: Excessive predation levels by native species can occur when alternate prey items are not available or the giant garter snake habitat has been degraded (usually by loss of cover). These problems can occur as a result of a variety of management actions including weed abatement, rodent control, and overgrazing. Integrated management for production and conservation could minimize these hazards.

Haz4: Predation by non-native snakes, fish (mostly cetrarchids), and bullfrogs is another hazard for giant garter snake. These introduced species live in permanent or semi-permanent waters, so shutting off irrigation water during the giant garter snake's inactive season, along with control efforts on the exotics, can help eliminate this problem.

Haz5: Giant garter snake can be killed during ditch maintenance or dredging if these activities occur during their inactive season. However, if these activities are conducted during the giant garter snake's active season they usually can escape.

Haz6: Loss of escape cover, through vegetation management or overgrazing, is another hazard for the giant garter snake. Integrated management for production and conservation needs to include protection of riparian and emergent vegetation during the giant garter snakes' active season.

Haz7: Snakes are killed by vehicles when roads are close to their habitat. Conservation areas should be well isolated from development; if this is not feasible, culverts and barriers should be installed to separate snakes from automobiles.

Haz8: Toxic contamination has been shown to be another hazard to the giant garter snake. Contaminants bioaccumulate and can result in weakened immune systems. Over-application of pesticides and the concentration of toxin-bearing runoff must be addressed in areas inhabited by this species.

Reproduction

Rep1: Population density should be adequate for mate finding in abundant, well connected habitat, but habitat loss and fragmentation have been severe in Placer County. Retention of rice fields and wetland restoration can help mitigate this problem.

Rep2: Giant garter snake bears live young (ovoviviparity). Reproductive success depends upon adequate food and escape cover for young giant garter snakes, both of which require healthy wetland ecosystems. Improper pesticide applications, overgrazing, and other activities that degrade these ecosystems must be addressed in management plans associated with conservation easements on farmland.

Dispersal

Dis1: Giant garter snake usually remains close to water, but has been known to venture 800 feet into adjacent upland areas. Thus, substantial buffers should be maintained around wetlands or rice fields known to support the snakes.

Dis2: If a habitat patch becomes unsuitable, giant garter snakes can move up to five miles to find a suitable one. Thus, the proximity of other wetlands or rice fields, managed to be compatible with the giant garter snake's needs and connected by suitable dispersal habitat, are critical to giant garter snake conservation.

Summary

The giant garter snake now depends almost entirely on agriculture, particularly rice growing, for its continued existence. Managing rice fields in ways compatible with the needs of giant garter snakes is quite possible, and these management prescriptions should be spelled out in agricultural/conservation easements. Restoring large fresh emergent wetlands would lessen the giant garter snake's dependence on agriculture.

Giant Garter Snake, *Thamnophis gigas*

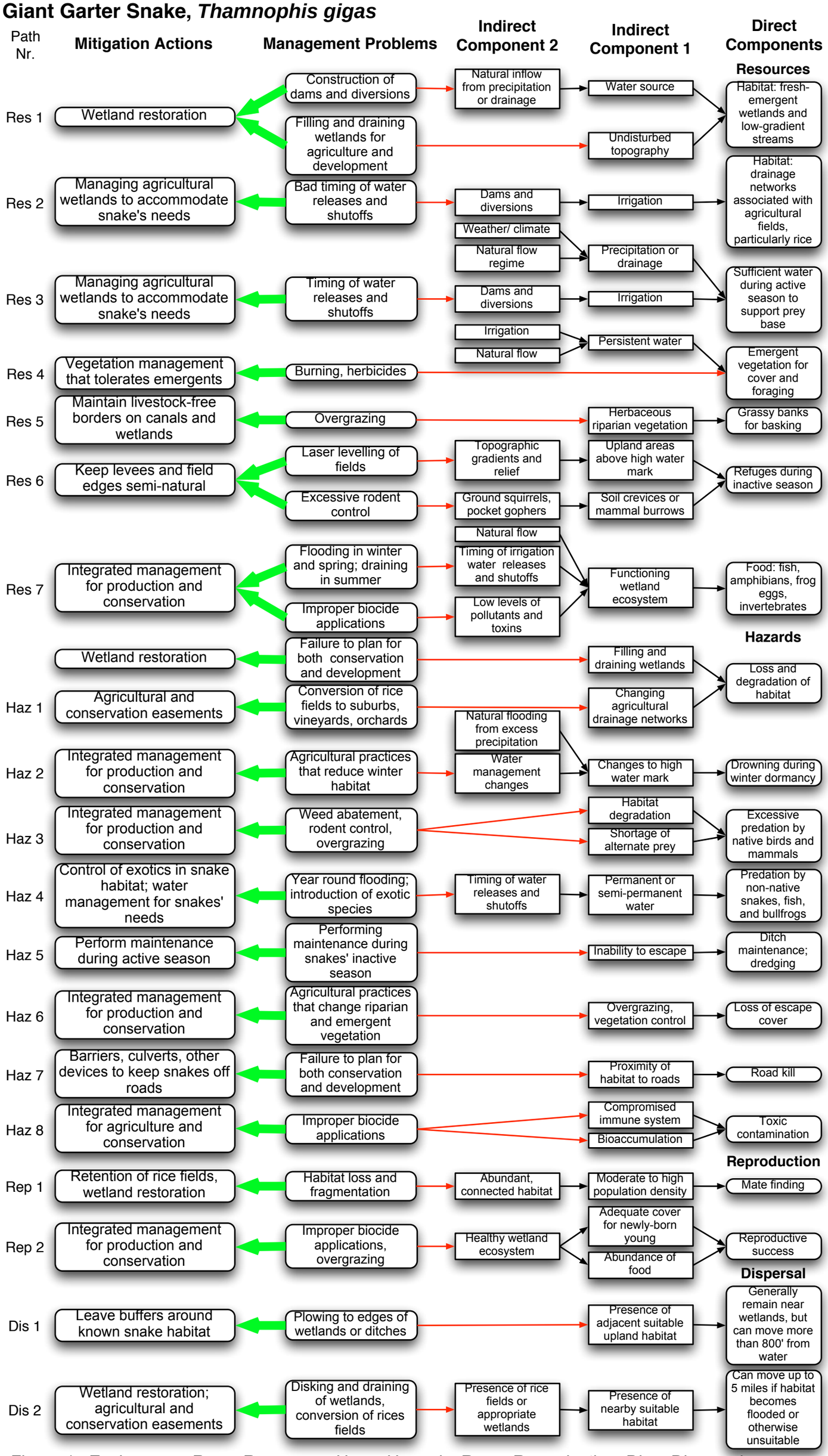

Figure 1. Envirogram. Res = Resources; Haz = Hazards; Rep = Reproduction; Dis = Dispersal.

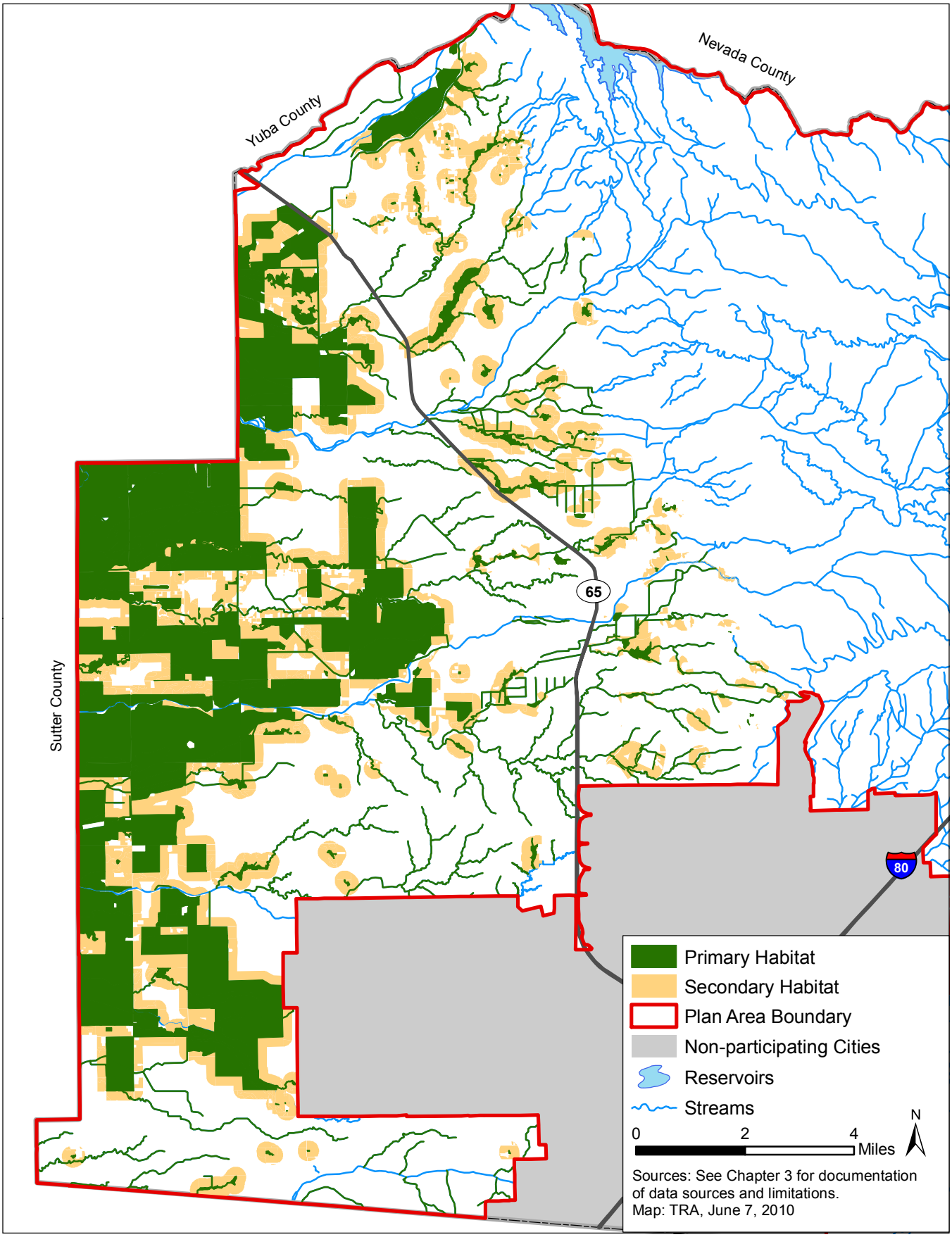

Figure 2. Giant garter snake modeled habitat distribution. The habitat map present outcomes of the draft model described above. The purpose of the model is to identify areas within the Plan area where the species occurs or could occur based on known habitat requirements. Those data on which this map is based are regional in scale. This map should not be used for site planning and should be verified in the field.